

Space Weather Technical Forecast

Issued on Monday, 11 July 2022 at 13:24 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Further M-class flares likely with a slight chance of X class flares giving R1 to R3 Radio Blackouts. Chance of G1/Minor Storms mainly late day 2 (12th) into day 3 (13th).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Moderate with two M class flares observed from AR3056 in the SE. A filament lift-off was also observed around 10/1700 UTC, which resulted in a CME visible off the southwest limb. Enlil suggests this CME is not Earth-directed. No other Earth-directed CMEs were observed.

There are seven numbered sunspots on the disc. AR3055 remains the largest and most complex region. It hasn't produced any significant flares. The next largest region is AR3053. It has not changed much since the last analysis. AR3046, AR3052 and A3052 appear relatively unchanged or slightly decaying. Two regions have recently been numbered on the eastern limb. AR3056 in the SE has been responsible for the recent M flares. 3056 continues to develop and become magnetically complex, with the possibility that a delta spot may be forming within its leading penumbra. 3057 in the NE is now clearly a bipolar region and appears quite large so will be closely monitored for signs of development.

There are currently numerous large filaments on the Sun, with the southern hemisphere in particular harbouring two large features that each span roughly 20 degrees on the solar disc. There were no signs on instability in these in the reporting period, however they will become increasingly relevant should they lift off in the coming few days, and will be monitored.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by DSCOVR at L1, remained slow-ambient below 400km/s. The solar wind density was largely Average or briefly slightly above average. The IMF was weak with brief moderate periods at the beginning and end of the period. The north-south component ranged between +6 and -6nT at first, whereas it was negligible for most of the period. The phi angle was mostly positive (away from the sun). The resultant geomagnetic activity was Quiet (Kp 1-2).

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV), as measured by GOES16, is back to background levels and on a decreasing trend, after it became enhanced in the wake of the C8.5 flare that occurred on the 09th.

The high energy electron flux (greater than 2 MeV) remained at Normal Background levels. The corresponding 24-hour integrated electron fluence remained well below the Active (1e8 integrated pfu) threshold on a roughly level trend. Observed fluence was 1.52e6 integrated pfu at 11/0001 UTC.

Four-Day Space Weather Forecast Summary

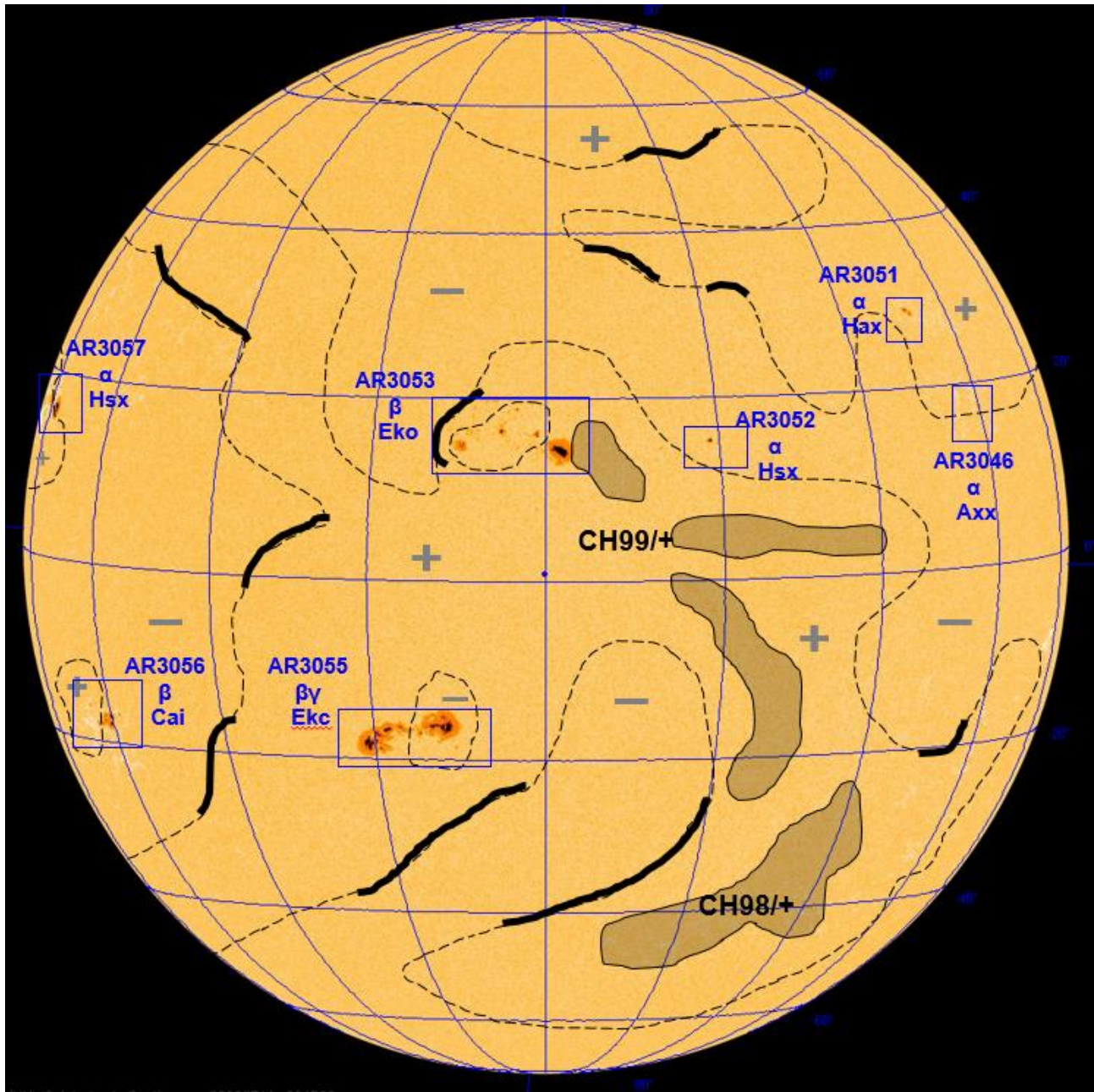
Solar Activity: Solar activity is Likely to be Moderate, with further M-class flares and a Slight Chance of X class flares. There remains a possibility of further sunspot regions emerging over the eastern limb.

Solar Wind / Geomagnetic Activity: A glancing blow from a CME may affect Earth late on day 1 (11th July) but confidence is low. Another and more prominent CME may arrive at Earth at the end of day 2 (12th) or on day 3 (13th). Solar winds may become enhanced today, under the influence of the HSS from CH99/+, and stay elevated through much of the forecast period. Geomagnetic activity is expected to be largely Quiet to Unsettled with a chance of an Active interval on days 1 and 2 (11th and 12th) but to become increasingly Unsettled and Active at the end of day 2 and into day 3 (12th and 13th), with a significant Chance of G1/Minor or G2/Moderate Storms under the influence of the CME that left the sun late on 9th July. During day 4 (14th) geomagnetic activity is expected to return to mainly Quiet.

Energetic Particles / Solar Radiation: Unless there is significant sunspot development, the high energy proton flux (greater than 10 MeV) is likely to remain at Background levels. There is however a daily Slight Chance of S1 or greater, due to the presence of two relatively large sunspot regions on the visible disk.

The high energy electron flux (greater than 2MeV) may increase at the end of this period, but the corresponding fluence is expected to remain well below the Active threshold (1e8 integrated pfu).

Figure 1. Solar Analysis Valid 11/0700 UTC.



Key: Filament — , Prominence — , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

A large CME was observed leaving the sun in the late hours of the 8th, in association with a long duration M2 flare. Its analysis revealed that while the bulk of the ejecta is expected to miss behind Earth's orbit, there is a slight chance of a glancing blow later on day 1 (11th). Another CME was also observed, this time in the late hours of the 9th and originating AR3052, which was near the central meridian at the time. This CME is expected to be much more prominent and should arrive at Earth late on day 2 (12th) or early on day 3 (13th).

The solar wind is at slow-ambient levels. The next coronal hole worthy of note is the fragmented CH99/+. It is a recurring feature that generated speeds of 600 km/s on the previous rotation, however, due to its smaller size and fragmentation in the intervening month, it is hard to envisage similar will be achieved this time around.

STEREO A does show an analogous enhancement in recent hours associated with a positive phi angle, which would correlate to an arrival at Earth on Monday 11 July which would be 24 hours earlier than expected versus SWPM. CH98/+ may contribute to this enhancement however its input is considered minor, being further away from the Earth ecliptic latitude.

Geomagnetic activity is expected to be largely Quiet to Unsettled with a chance of an Active interval on days 1 and 2 (11th and 12th) but to become increasingly Unsettled and Active at the end of day 2 and into day 3 (12th and 13th), with a Chance of G1/Minor Storms under the influence of the CME that left the sun late on 9 July. During day 4 (14th) geomagnetic activity is expected to return to mainly Quiet.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	10	30	50	10
Strong	G3	No	1	2	5	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
09/0047UTC	Partial Halo	AR3053	NE quadrant	1072 km/s	11/1800 UTC +/- 6 hrs	Limited shock
10/0500 UTC	Partial halo	AR3052	NE quadrant	918 km/s	12/2200 UTC +/- 6 hrs	More prominent shock.

Radio Blackouts - X-Ray Flares:

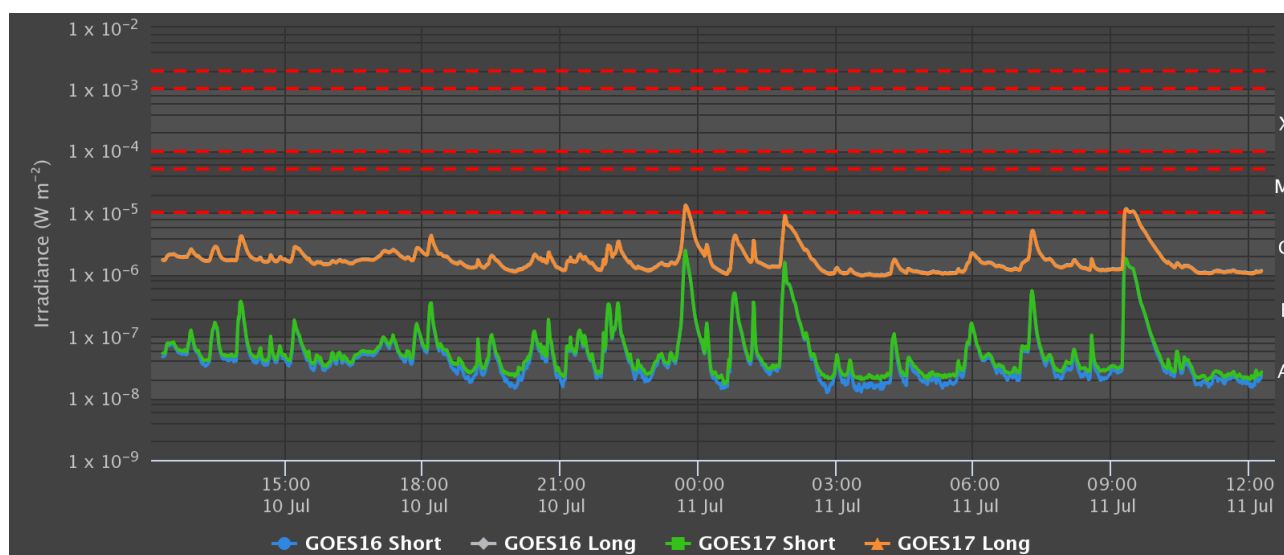
Solar activity was Moderate, with two M class flares from AR3056 in the southeast. This region may be becoming complex with the possibility of a delta spot forming within its leading penumbra.

There are seven numbered sunspots on the disc. AR3055 remains the largest and most complex region, though it hasn't flared significantly. The next largest region is AR3053. This region also appears stable. AR3046, AR3051 and A3052 remain relatively unchanged or are slightly decaying. One other region has emerged around the northeast limb. 3057 is now clearly a bi-polar region, and appears quite large so will be closely monitored for signs of growth.

Solar activity is Likely to remain Moderate with further M class flares and a Slight Chance of X class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	60	60	60	60
Very Active	R3 to R5 X Class	No	15	15	15	15

Figure 2: GOES16 X-Ray flares show two weak M-class flares



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is now back to background levels, after it became slightly elevated on the 09th (in response to a C8 flare). Flux levels are therefore starting from a slightly higher baseline, with two relatively large sunspot regions transiting across the disk and further regions emerging. There is a slight chance of an S1 in the next four days.

Radiation Storms	Level (cm ⁻² sr ⁻¹ s ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	10	10	20	20
Very Active	≥ S3 *	No	1	1	1	1

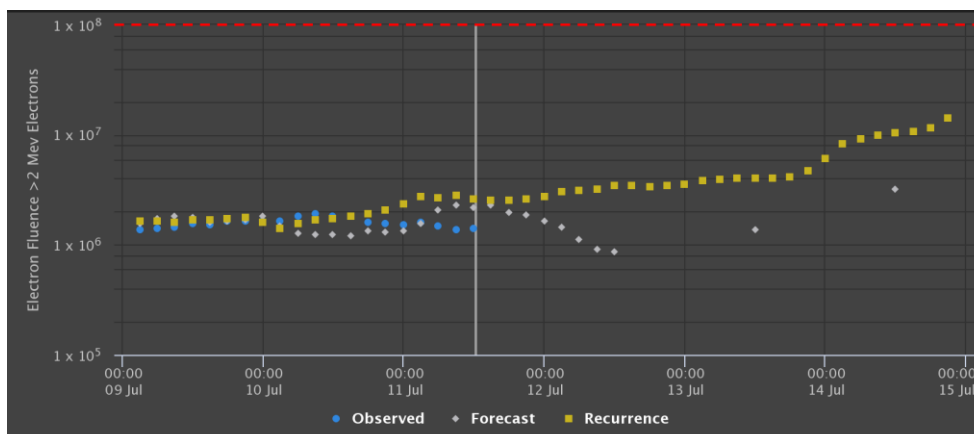
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = cm⁻²sr⁻¹s⁻¹)

High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV) is currently at Normal Background levels. While CH99/+ is a recurring feature, it is much-changed in comparison with the previous rotation and as such, confidence is relatively low. The expected arrival of the high speed stream and a Slight Chance of a G1 ought to prevent any significant increase in flux levels over the next few days, at least until midweek when a new equilibrium can be achieved. The corresponding fluence is therefore very unlikely to exceed the Active threshold (1e8 integrated pfu) during this period.

GEO Electron Environment	Level (cm ⁻² sr ⁻¹ day ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1x10 ⁸	No	1	5	10	10
Very Active	≥ 2 MeV ≥ 1x10 ⁹	No	1	1	1	1

Figure 3: Fluence staying well below 1e8 integrated pfu Active level.



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